DO WE HAVE METEORITES FROM THE VERITAS ASTEROID BREAK-UP EVENT 8 MA AGO?

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Introduction: A strong ^{3}He peak in deep sea sediments [1] points to the largest asteroid break-up event in the last 100 Ma, the formation of the Veritas family 8.3±0.5 Ma ago [2] (perhaps 8.1±0.1 Ma, see [3]). The young age of the family has allowed the reconstruction precursor asteroids orbit and position at time of break-up, from the back-extrapolated orbits of the family members [2,4]. From a similar event, the break-up of the L chondrite parent body (LCBP) 470 Ma ago, the flux of extraterrestrial material reaching the Earth after a break-up can be ~100 times higher [5] if the disrupted asteroid is close to an orbital resonance [6]. The Brunflo fossil meteorite, which was found in a layer ca. 5 Ma younger than the LCPB break-up event [7], demonstrates that numerous fragments still reached the Earth several Ma later. Up to 25% of the interplanetary dust reaching the Earth today might be from Veritas [2], but we do not know of any "Veritas meteorites" in our collections. Such meteorites should have a reflectance spectrum matching the Ch/C/Cg-type Veritas family, similar to CM chondrites [8], and a cosmic-ray exposure (CRE) age of about 8 Ma (younger if they are from secondary collisions). Most CM chondrites have CRE ages much shorter than 8 Ma (and none longer), with a distinct peak at <1 Ma in the probability distribution diagram (Fig. 1), but a few CM chondrites do have CRE ages compatible with the Veritas event. Here we report the ^{21}Ne-based CRE ages of two additional CM chondrites, Jbilet Winselwan, and Cimarron. We also model the evolution of meteoroids (and their daughter fragments from secondary collisions) ejected ca. 8 Ma ago at the barycenter of the Veritas family, to constrain the efficiency of delivering Veritas fragments to Earth and estimate their present-day flux.

Methods: He, Ne, and Ar were measured as explained in [9]. Data for the PD diagram were compiled from [10]. For the meteoroid model, we simulated test particles with radii >0.1 m ejected at the Veritas family barycenter at the time of break-up, and then evolved them for 10 Ma using GENGA, a fast n-body integrator [11], taking into account Yarkovsky drift and Poynting-Robertson drag, collisional break-ups and collisional resets of the rotation rates [12].

Results & Discussion: The Ne isotopic composition of Cimarron and Jbilet Winselwan is a mix between cosmogenic and primordial noble gases, with the latter meteorite having both more cosmogenic Ne (^{21}Ne/^{22}Ne ~0.41) and also a factor of ~2 more primordial gases. Solar wind noble gases were not detected in both meteorites. Since the shielding conditions under which these meteorites were irradiated are unknown, we adopt a ^{21}Ne production rate of 0.20±0.05 × 10^{-8} cm^3 STP/gMa (based on CM chemistry and the models by [13]), which encompasses most shielding conditions. The CRE age is 0.35±0.10 Ma for Cimarron and 6.6±1.7 Ma for Jbilet Winselwan. While the short CRE age of Cimarron is typical for CM chondrites, the one for Jbilet Winselwan is among the highest known (e.g. Erakot, Santa Cruz, and Y-793321; see Fig. 1). The high CRE age of Jbilet Winselwan is compatible, within uncertainty, with an ejection at the time of the Veritas break-up (8.3±0.5 Ma), as are ~1/6 of all CM chondrites with known ^{21}Ne-based exposure ages. Of the meteorites reaching the Earth (about 3-7 tons/a for final masses between 10 g and 1 kg [14]), CM chondrites contribute about 1.5%, based on observed falls [15]. The present-day flux of potential "direct" Veritas fragments is, therefore, <0.3% or <10-20 kg/a (might be higher if some CM chondrites with shorter ages are derived from secondary collisions among Veritas fragments). Whether this is compatible with the results of the simulation will be presented at the conference.

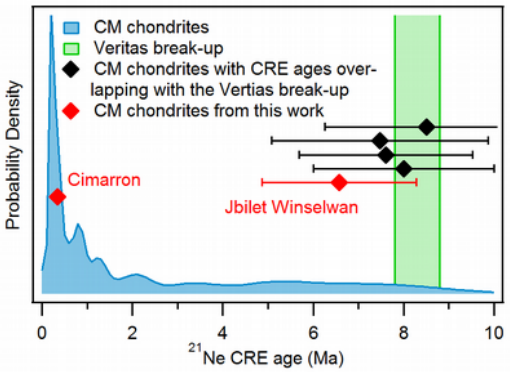

***Figure 1**: PD diagram of CM chondrite CRE ages*

Acknowledgements: This work was supported by the Swiss National Science Foundation (MM) and the NCCR PlanetS collaboration (SG). We thank M. Zolensky and Y. Marrocchi for providing samples.

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